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PLANT HORMONE TYPES AND EFFECTS ON PLANT GROWTH

BİTKİ HORMON ÇEŞİTLERİ VE BİTKİ BÜYÜMESİNE ETKİLERİ

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ABSTRACT

Plants, starting from the germination of the seed in the vital process, until the formation of a new seed in the organization of all physiological events; they benefit from the chemical messengers they produce. These growth regulators, which are synthesized naturally as part of their metabolism, are plant hormones. However, there are also synthetic hormones used in plant production in agriculture. These artificial hormones are called plant growth regulators (PGR). Although there are a number of plant hormones identified today, there are five main plant hormone groups, mainly stimulating plant growth - oxins, cytokinins and gibberellins, and inhibiting growth - absicic acid and ethylene. All hormones are generally synthesized in the young organs of the plant. The only gaseous plant hormone is ethylene. And unlike other hormones, ethylene is more common in ripe fruits and aged leaves. In agriculture and tissue culture studies, the development of different parts of the plant can be encouraged by combining different proportions of plant hormones.

Keywords: Plant hormones, plant growth regulators, auxins, cytokinins, gibberellins.

ÖZET

Bitkiler, tohumun çimlenmesinden itibaren başlayan yaşamsal süreçlerinde, kendisinin de yeni bir tohum oluşturuncaya kadarki tüm fizyolojik olayların organizasyonlarında; bünyelerinde ürettikleri kimyasal habercilerden yararlanırlar. Metabolizmalarının bir parçası olarak doğal halde sentezlenen bu büyüme düzenleyicileri bitkisel hormonlardır. Bununla birlikte, tarımda bitki üretiminde kullanılan sentetik hormonlar da mevcuttur. Bu yapay hormonlara daha çok bitki büyüme düzenleyicileri (BBD) adı verilmektedir. Günümüzde tespit edilmiş çok sayıda bitki hormonu olmasına karşın, temel olarak bitkinin büyümesini teşvik eden – oksinler, sitokininler ve gibberellinler - ve büyümeyi engelleyen – absisik asit ve etilen - olmak üzere beş ana bitkisel hormon grubu bulunmaktadır. Bütün hormonlar genel olarak bitkinin genç organlarında sentezlenirler. Gaz formunda olan tek bitkisel hormon etilendir. Ve etilen diğer hormonların aksine olgunlaşmış meyvede ve yaşlanmış yapraklarda daha çok görülür. Tarımda ve doku kültürü çalışmalarında, bitkisel hormonların farklı oranlarda kombinasyonları ile bitkinin farklı kısımlarının gelişimleri teşvik edilebilmektedir.

Anahtar Kelimeler: Bitki hormonları, bitki büyüme düzenleyicileri, oksin, sitokinin, giberellin.

1. INTRODUCTION

Plants with no nervous system and no developed endocrine system; they provide the guidance and organization they need to grow, develop and create an environmental response through the hormones they produce within their body. Hormones play very effective roles in maintaining plants' internal

mechanisms and communicating with other living things. In this sense, it is not wrong to call plant hormones as plant precursors or plant growth regulators (PGR). These substances can be obtained from various organs of some plants and some fungi (Morsünbül et al., 2010). These messenger chemicals are active in many physiological events such as defoliation, flowering, fruit formation and coloration, orientation to light, self-defense against pests.

The first information on plant growth regulators dates back to the early 20th century. Afterwards, the role of growth regulators in plant growth and development has been revealed and important natural and synthetic substances have been discovered for fruits / vegetables (Halloran and Kasım, 2002).

Vegetable hormones, which are simple, are synthesized in small amounts by plants. These herbal messengers, which are mostly produced in the young cells of seeds, fruits and leaves, as well as at the root and stem ends; mostly the target is moved to other cells and used there. Vegetable hormones synthesized in the plant are biochemical substances that can be transported from where they are synthesized and show their effectiveness even in a very small amount (Ergun, 2017).

The features that should be in plant hormone are as follows (Kaynak and Ersoy, 1997); This means that the plant is formed within the body, can be moved from one place to another, manage or regulate different life events at the place it is moved, and this can be effective even at very low concentrations.

Plant hormones induce cell division, cell elongation and cell differentiation by regulating the expression of transcription factors and cell type-specific genes (Johri and Mitra, 2001).

Plant hormones, which can be effective in many biological events, even in very small amounts, are not only specific to certain organs and tissues, but can be effective in all parts of the plant. And they play a role in all stages of growth and development, from germination to cell death (Ergun, M. 2017).

Naturally produced plant hormones are collected in five main groups. These are auxin, cytokinin, gibberellin, absicic acid and ethylene. These are also present in artificially produced plant hormones. These are called growth regulators. In particular, there are artificially produced variants of auxin, cytokinin and ethylene hormones. Although the chemical structures of auxin and cytokinin are not the same as natural plant hormones, they have similar effects on plants. Due to the fact that natural hormones are produced by plants in limited quantities and are very difficult to purify in industry; these growth regulators, which give similar effects, are very popular and are used in agriculture. It is estimated that up to 100,000 substances per year can be used in agriculture in Europe (Seçer, 1991).

Among the natural BBDs, ethylene is the most widely used plant hormone in the world with a rate of 23%. Cytokinin is not yet widely used in the world. (Barut, 1995).

Auxins, cytokinins and gibberellins stimulate growth; ethylene is the hormone that plays a regulatory role in fruit ripening (Fırat, 1998; Walsh, 2003).

Plant hormones should be used in very low amounts when used in agriculture. If this happens, it is possible for the plant to break down into harmless levels. As long as the amounts needed in agricultural practices are not exceeded, concerns about human health are also lessened. If the available amounts are exceeded, plant hormones can increase crop yields in plants, but fruit can also cause abnormal growth.

Plant hormones grouped by old classical evaluations as auxin, cytokinin, gibberellin, ethylene and abscisic acid; Today, new ones called vegetable hormones such as jasmonic acid, salicylic acid, brassinosteroids, polyamines and nitric acid have been added (Ergun, M. 2017).

2. HERBAL HORMONE TYPES

2.1. Plant Growth Hormones

2.1.1. Auxins

Auxins stimulate growth by secreting especially at the ends of plant organs. When excessively secreted, they inhibit growth. Auxins play a role in blooming, foliation and fruit formation. They also encourage rooting in the plant. They are effective in conduction tissue differentiation. They are also effective in turning the plant towards light. Artificial auxins are used in agriculture to combat weeds. Some synthetic auxins such as 2,4-D and picloram cause functional disorders on weeds, such as phloem transport and photosynthesis (Kaynak & Memiş, 1997).

They are usually substances that cause growth in plants, and cell growth, tissue development and root formation are encouraged by these. They are synthesized by all highly structured plants and the most common form of auxin is Indole-3-acetic acid (IAA) (Grunewald et al., 2009). IAA is the only plant that can be synthesized naturally in plants. However, it has been determined that some synthetic substances have similar effects to IAA (Kumlay and Eryigit, 2011).

When the plant is secreted less, the growth of the plant slows down and the foliage accelerates. They also take part in the opening of the stomata.

Auxins are the hormones used in agriculture since the oldest (Halloran and Kasım, 2002). They are also the most widely used plant growth regulators. Artificial forms are used in agriculture. Naphthalene acetic acid, 2,4 dichloro phenoxy acetic acid, indole-3-acetic acid are available in many varieties.

2.1.2. Cytokinins

Cytokinins are mostly produced in the roots and stimulate the growth of the roots. They are involved in bud development and prolongation of leaves. They are effective in promoting seed germination and delaying plant aging. They stimulate the synthesis of chlorophyll and keep the leaves green.

The commonly used form of artificial cytokine in agriculture is benzyl adenine. Florists use cytokinin to delay the aging of the plant.

In plant tissue culture studies, cytokinin and auxin were used together; development of different parts of the plant can be provided. After callus tissue is generated from an explant obtained from the plant by tissue culture techniques, the development of the desired parts of the plant can be encouraged by different proportional applications of auxin and cytokinin.

If equal amounts of auxin and cytokine are used, callus tissue is formed without differentiation. If auxin is used more than cytokine, the formation of root in callus tissue is promoted. If cytokine is used more than oxine, shoot and leaf formation is observed in the callus (Kaynak and Ersoy, 1997).

2.1.3. Gibberellins

Gibberellins are synthesized in the roots, young leaves and embryos of the plant. They stimulate elongation of stem and leaves and stimulates flowering. In addition, gibberellins break the dormancy of the seed and cause germination. They are also effective for fruit growth and seedless fruit formation.

It was first isolated from *Gibberella fujikuroi* (Saw) mushrooms in Japan and it was noticed that this mushroom caused excessive lengthening of paddy (Seçer, 1989).

If the Gibberellins are given too much to the plant, the length of the plant will increase abnormally, and if given less, the dwarf plant will form.

2.2. Hormones That Inhibit Plant Growth

2.2.1. Absicic Acid

Absisic acid is produced in fresh leaves, root tips, buds and seed embryos. It is called "ABA" in short. It stops growing and developing in general. ABA ensures that the seeds and buds remain dormant, prevents the seed from germinating under unfavorable conditions, and encourages the stomata to remain closed in extreme weather conditions. It also prevents the loss of leaves, flowers and fruits. It can be synthesized in almost all plant tissues. Unlike hormones that promote growth in plants, the most important substance that prevents their development is ABA (Morsünbül et al., 2010).

It is normally present in high amounts in dormancy seeds and buds and is thought to have a sustaining effect on dormancy. However, the leaves are also found in the stem and fruits (Kumlay and Eryiğit, 2011).

2.2.2. Ethylene

Ethylene is produced in ripe fruits, aged leaves and flowers. It is the only plant hormone that is gaseous and produced by the plant itself (Westwood, 1993) and is produced where it is used because of transport difficulties. Due to its gas form, it also affects the surrounding plants. For example, a tree blooming in a garden can encourage others to bloom through ethylene gas. It prevents the growth of the plant, especially provides the ripening of fruits. On the other hand, since it is also gaseous, it can easily spread to the environment, so it can decompose the surrounding fruits.

Ethylene, also called ripening hormone, is the most commonly used plant regulator after post-skin technology. It is used in the protection and preservation of many garden products (Ergun, M. 2017). If the value in the air is more than 10ppm, the physiological effect value of ethylene begins. It is considered as a stress hormone rather than a ripening hormone by ethylene researchers. (Karaçalı, İ. 2012).

Ethylene gas promotes the increase of sugars and ripening in fruit. If ethylene production continues at this stage, the fruit may rot. In agriculture, ethylene is often used for yellowing peels of green bananas, tangerines and lemons.

Ethylene production in the stressed plant is accelerated, and most ethylene can be detected at the last stage of the plant's life. At the time of casting, the amount of ethylene in the leaves is expected to be high. It is known that ethylene is also effective in fading flowers. Ethylene also plays a role in seed germination and budding events.

If the amount of auxin in the plant increases above a certain level, ethylene production is stimulated. The produced ethylene suppresses the action of auxin and stops the growth of the plant.

3. RESULTS AND DISCUSSION

Plant hormones are chemical messengers that can show their effects even at low concentrations and organize plant metabolism by affecting physiological processes. Affected processes mainly consist of growth, differentiation and development, but other processes such as stoma movement may also be affected. Plant hormones are also called phytohormones, but this term is rarely used (Davies, 2010). Although there are a wide variety of plant hormones, they generally fall into two main groups as those that promote and inhibit growth. Some of these plant hormones are also artificially synthesized in commercially available forms, which will give effects similar to those of the plant. Nowadays, they are often used to increase fruit yield and quantity. For example, to obtain seedless grapes and banana, tangerine, lemon fruit, such as yellow ripening of the early use in agriculture to provide maturation areas are available.

In addition to these general plant hormones, plant growth regulators such as salicylic acid, brassinostreroid, polyamine and jasmonic acid, which are naturally derived or artificially synthesized from plants, are also available (Ergun, M. 2017).

After the 20th century, the role of growth regulators in plant growth and development has been revealed and important natural and synthetic substances have been discovered for fruits / vegetables (Halloran and November, 2002).

Growth regulators, which can be effective even in very small amounts, are studied in the same group as pesticides. Although the effects of plant hormones on the environment are too small to be compared with pesticides, it has been demonstrated in studies that negative effects may occur in living things as a result of misuse (Algül et al. 2016).

With the ongoing applications of plant tissue culture techniques and studies on plant physiology; The effects of different combinations of natural herbal hormones and artificial hormones on plants are investigated. In this way, the roles of plant hormones in plant metabolism will be further elucidated and their contribution to agricultural economy will be increased.

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